The listing of Claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1-8. (Canceled)

9. (Currently Amended) An apparatus that scales a digital image signal comprising:

a memory unit, which receives originally formatted input pixel data, updates and stores the pixel data on a plurality of lines passing through an interpolation location, and outputs the updated pixel data in response to a control signal;

a scaling interpolator, which determines a direction of interpolation of the interpolation location from LPF-filtered data of the updated pixel data in response to the control signal, calculates pixel data values at points where an extended line that passes through the interpolation location and extending in the direction of interpolation intersects horizontal or vertical lines of the display using Lagrangian or polyphase filtering wherein the points are not included in the originally formatted input pixel data, applies Lagrangian filtering to the calculated pixel data on the extended line, and obtains and outputs interpolation data of the interpolation location to provide an interpolated pixel value to a display to provide a scaled-up image thereon compared to the originally formatted input pixel data[[ ]]; and

a controller which generates the control signal, which controls the LPF-filtering, and the Lagrangian filtering or polyphase filtering,

wherein the scaling interpolator comprises:

a direction determination unit, which LPF-filters the updated pixel data in response to the control signal, determines the direction value which corresponds to the direction of interpolation of the interpolation location from the LPF-filtered data, and outputs the direction value; and

a directional interpolator, which calculates the pixel data values of the intersections of the horizontal (or vertical) lines and the extended line using Lagrangain in response to the control signal, applies Lagrangian filtering to the

calculated pixel data, and obtains and outputs the interpolation data of the interpolation location,

wherein the LPF filtering is performed by an LPF with the property:

$$x'(i,j)=\frac{x(i-1,j)+6\times x(i,j)+x(i+1,j)}{8},$$

wherein x'(i, j) is the filtered data and x(i, j) is pixel data at the i-th row and j-th column.

10-11. (Canceled)

12. (Currently Amended) The apparatus of claim [[10]]9, wherein the direction of interpolation is determined by a direction value that is linearly changed between a direction value of a pixel P1 above (or to the left of) the interpolation location and a direction value of a pixel P2 below (or to the right of) the interpolation location according to the interpolation location, if the direction values of two pixels P1 and P2 above and below the interpolation location are each represented by seven values of 1 through 7.

13. (Currently Amended) An apparatus that scales a digital image signal comprising:

a memory unit, which receives originally formatted input pixel data, updates and stores the pixel data on a plurality of lines passing through an interpolation location, and outputs the updated pixel data in response to a control signal;

a scaling interpolator, which determines a direction of interpolation of the interpolation location from LPF-filtered data of the updated pixel data in response to the control signal, calculates pixel data values at points where an extended line that passes through the interpolation location and extending in the direction of interpolation intersects horizontal or vertical lines of the display using Lagrangian or polyphase filtering wherein the points are not included in the originally formatted input pixel data, applies Lagrangian filtering to the calculated pixel data on the extended line, and obtains and outputs interpolation data of the interpolation location to provide an interpolated

pixel value to a display to provide a scaled-up image thereon compared to the originally formatted input pixel data; and

a controller which generates the control signal, which controls the LPF-filtering, and the Lagrangian filtering or polyphase filtering,

wherein the scaling interpolator comprises:

a direction determination unit, which LPF-filters the updated pixel data in response to the control signal, determines the direction value which corresponds to the direction of interpolation of the interpolation location from the LPF-filtered data, and outputs the direction value; and

a directional interpolator, which calculates the pixel data values of the intersections of the horizontal (or vertical) lines and the extended line using Lagrangain in response to the control signal, applies Lagrangian filtering to the calculated pixel data, and obtains and outputs the interpolation data of the interpolation location,

wherein the direction of interpolation is determined by a direction value that is linearly changed between a direction value of a pixel P1 above (or to the left of) the interpolation location and a direction value of a pixel P2 below (or to the right of) the interpolation location according to the interpolation location, if the direction values of two pixels P1 and P2 above and below the interpolation location are each represented by seven values of 1 through 7,

~~The apparatus of claim 12,~~ wherein the direction value of the pixel is determined by:

$$If \left| W_{dir_{GLOBAL}} \cdot Pe_{dir_{GLOBAL}} - W_{dir_{LOCAL}} \cdot Pe_{dir_{LOCAL}} \right| < T$$

$$DIR_i = DIR_{LOCAL},$$

$$else$$

$$DIR_i = DIR_{GLOBAL},$$

where, $Pe_{dir} = \sum_{k=0}^{n-1} a\left|x'_p(i,j:k) - x'(i,j)\right|$ is used to calculate a difference between the LPF-filtered data and the updated pixel data, $W_{dir} = \begin{cases} 1.0 & dir = 1 \\ 1.25 & dir = 2,3 \\ 1.375 & dir = 4,5 \\ 1.5 & dir = 6,7 \end{cases}$ is used for calculating a weighted value, and $DIR_{LOCAL} = \underset{dir}{ARG}\left\{\min_{1\le dir\le 3}(W_{dir} \times Pe_{dir})\right\}$ and $DIR_{GLOBAL} = \underset{dir}{ARG}\left\{\min_{1\le dir\le 7}(W_{dir} \times Pe_{dir})\right\}$ are used to calculate the direction value according to the minimal value of W_{dir} x Pe_{dir};

wherein, k is a reference index representing one of five pairs of pixels, x'(i, j) is the LPF-filtered pixel data, $x'_p(i, j:k)$ is the average value of the pixel data corresponding to the reference index k for data situated about the reference pixel in each of the seven directions, a is a weighted value according to k, wherein a=2 if k is the value corresponding to the pair centered around the reference pixel, and a=1 otherwise, DIR_{LOCAL} is a local direction value, DIR_{GLOBAL} is a global direction value, DIR_i is a final direction value, and T is a constant representing a threshold value that depends on an image noise.

14. (Currently Amended) An apparatus that scales a digital image signal comprising:

a memory unit, which receives originally formatted input pixel data, updates and stores the pixel data on a plurality of lines passing through an interpolation location, and outputs the updated pixel data in response to a control signal;

a scaling interpolator, which determines a direction of interpolation of the interpolation location from LPF-filtered data of the updated pixel data in response to the control signal, calculates pixel data values at points where an extended line that passes through the interpolation location and extending in the direction of interpolation intersects horizontal or vertical lines of the display using Lagrangian or polyphase filtering wherein the points are not included in the originally formatted input pixel data, applies Lagrangian filtering to the calculated pixel data on the extended line, and obtains

and outputs interpolation data of the interpolation location to provide an interpolated pixel value to a display to provide a scaled-up image thereon compared to the originally formatted input pixel data; and

a controller which generates the control signal, which controls the LPF-filtering, and the Lagrangian filtering or polyphase filtering,

wherein the scaling interpolator comprises:

a direction determination unit, which LPF-filters the updated pixel data in response to the control signal, determines the direction value which corresponds to the direction of interpolation of the interpolation location from the LPF-filtered data, and outputs the direction value; and

a directional interpolator, which calculates the pixel data values of the intersections of the horizontal (or vertical) lines and the extended line using Lagrangain in response to the control signal, applies Lagrangian filtering to the calculated pixel data, and obtains and outputs the interpolation data of the interpolation location,

~~The apparatus of claim 10,~~ wherein the Lagrangian or the polyphase filtering is performed by a Lagrangian filter or a polyphase filter using:

$$L_i(t) = \prod_{k=0, k\neq i}^{n} \frac{t-k}{i-k} \text{ and}$$

$$p_n(t) = \sum_{i=0}^{n} L_i(i)x(i),$$

wherein n is the number of pixels to be used for interpolation, t is a distance from the first pixel of the n pixels to the intersection location, and x(i) is pixel data at the respective intersections.

15. (Currently Amended) A scaling interpolation computer implemented method comprising:

receiving and LPF-filtering originally formatted pixel data on a plurality of lines passing through an interpolation location and determining a direction value, which is used for a direction of interpolation at the interpolation location from the LPF-filtered data and outputting the direction value;

calculating pixel data values at points where an extended line that passes through the interpolation location and extending in the direction of interpolation intersects horizontal or vertical lines of the display using Lagrangian or polyphase filtering wherein the points are not included in the originally formatted pixel data;

applying Lagrangian filtering to the calculated pixel data on the extended line; and

obtaining and outputting interpolation data of the interpolation location to provide an interpolated pixel value to a display to provide a scaled-up image thereon compared to the originally formatted input pixel data,

wherein the Lagrangian or the polyphase filtering is performed by a Lagrangian filter or a polyphase filter using:

$$L_i(t) = \prod_{k=0, k\neq i}^{n} \frac{t-k}{i-k}$$ and

$$p_n(t) = \sum_{i=0}^{n} L_i(i)x(i),$$

wherein n is the number of pixels to be used for interpolation, t is a distance from the first pixel of the n pixels to the intersection location, and x(i) is pixel data at the respective intersections.

16-17. (Canceled)

18. (Currently Amended) A scaling interpolation computer implemented method comprising:

receiving and LPF-filtering originally formatted pixel data on a plurality of lines passing through an interpolation location and determining a direction value, which is used for a direction of interpolation at the interpolation location from the LPF-filtered data and outputting the direction value;

calculating pixel data values at points where an extended line that passes through the interpolation location and extending in the direction of interpolation intersects

horizontal or vertical lines of the display using Lagrangian or polyphase filtering wherein the points are not included in the originally formatted pixel data;

applying Lagrangian filtering to the calculated pixel data on the extended line; and

obtaining and outputting interpolation data of the interpolation location to provide an interpolated pixel value to a display to provide a scaled-up image thereon compared to the originally formatted input pixel data,

~~The method of claim 15~~ wherein the LPF filtering is performed by an LPF with the property:

$$x'(i,j) = \frac{x(i-1,j) + 6 \times x(i,j) + x(i+1,j)}{8},$$

wherein x'(i, j) is the filtered data and x(i, j) is pixel data at the i-th row and j-th column.

19. (Original) The method of claim 15 wherein the direction of interpolation is determined by a direction value that is linearly changed between a direction value of a pixel P1 above (or to the left of) the interpolation location and a direction value of a pixel P2 below (or to the right of) the interpolation location according to the interpolation location, if the direction values of the two pixels P1 and P2 above and below the interpolation location are each represented by seven values of 1 through 7.

20. (Currently Amended) A scaling interpolation computer implemented method comprising:

receiving and LPF-filtering originally formatted pixel data on a plurality of lines passing through an interpolation location and determining a direction value, which is used for a direction of interpolation at the interpolation location from the LPF-filtered data and outputting the direction value;

calculating pixel data values at points where an extended line that passes through the interpolation location and extending in the direction of interpolation intersects horizontal or vertical lines of the display using Lagrangian or polyphase filtering wherein the points are not included in the originally formatted pixel data;

applying Lagrangian filtering to the calculated pixel data on the extended line; and

obtaining and outputting interpolation data of the interpolation location to provide an interpolated pixel value to a display to provide a scaled-up image thereon compared to the originally formatted input pixel data,

wherein the direction of interpolation is determined by a direction value that is linearly changed between a direction value of a pixel P1 above (or to the left of) the interpolation location and a direction value of a pixel P2 below (or to the right of) the interpolation location according to the interpolation location, if the direction values of the two pixels P1 and P2 above and below the interpolation location are each represented by seven values of 1 through 7,

~~The method of claim 19~~ wherein the direction value of the pixel is determined by:

$$If \left| W_{dir_{GLOBAL}} \cdot Pe_{dir_{GLOBAL}} - W_{dir_{LOCAL}} \cdot Pe_{dir_{LOCAL}} \right| < T$$

$$DIR_i = DIR_{LOCAL},$$

$$else$$

$$DIR_i = DIR_{GLOBAL},$$

where, $Pe_{dir} = \sum_{k=0}^{n-1} a \left| x'_p(i, j:k) - x'(i, j) \right|$ is used to calculate a difference between the LPF-filtered data and the updated pixel data, $W_{dir} = \begin{cases} 1.0 & dir = 1 \\ 1.25 & dir = 2,3 \\ 1.375 & dir = 4,5 \\ 1.5 & dir = 6,7 \end{cases}$ is used for calculating a weighted value, and $DIR_{LOCAL} = \underset{dir}{ARG}\left\{\min_{1 \le dir \le 3}(W_{dir} \times Pe_{dir})\right\}$ and $DIR_{GLOBAL} = \underset{dir}{ARG}\left\{\min_{1 \le dir \le 7}(W_{dir} \times Pe_{dir})\right\}$ are used to calculate the direction value according to the minimal value of W_{dir} x Pe_{dir};

wherein, k is a reference index representing one of five pairs of pixels, x'(i, j) is the LPF-filtered pixel data, $x'_p(i, j:k)$ is the average value of the pixel data corresponding to the reference index k for data situated about the reference pixel in each of the seven directions, a is a weighted value according to k, wherein a=2 if k is the value

corresponding to the pair centered around the reference pixel, and a=1 otherwise, DIR_{LOCAL} is a local direction value, DIR_{GLOBAL} is a global direction value, DIR_i is a final direction value, and T is a constant representing a threshold value that depends on an image noise.

21-28. (Canceled)